Status of the analysis chain for CBM-TOF demonstrator data

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The CBM experiment will apply for the first time a data driven data acquisition concept for all subsystems. We develop the TOF part of this system and present here the analysis chain of the CBM-TOF demonstrator. Testing is done using self-triggered data acquired last November at COSY, Jülich.

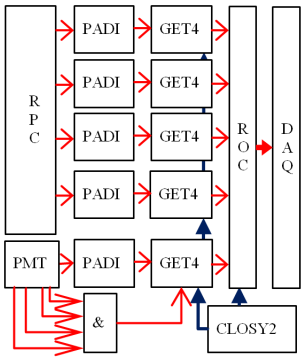

Figure 1: Setup used at COSY in Nov. 2010. RPC = Resistive Plate Chamber, PADI = pre-amplifier, GET4 = time digitizer, ROC = readout controller, CLOSY2 = Clock generation, PMT = 4 plastic scintillators read out by 2 photomultipliers each.

The setup used to take the test data is sketched in Fig. 1 and consists of a fully differential, 16-strips MMRPC [1], the full CBM-TOF readout chain [2] and the DABC DAQ. In total 40 channels were connected: 32 for the double-ended detector strips and 8 for the PMTs used as reference system. Additionally, a logic signal of the coincidence of the four main PMTs was fed into the external synchronization input (ExtSync) of one TDC, giving a reference point in the data stream. Three runs were recorded, amounting for 40 GB of data and around 1.5M "events" (ExtSync).

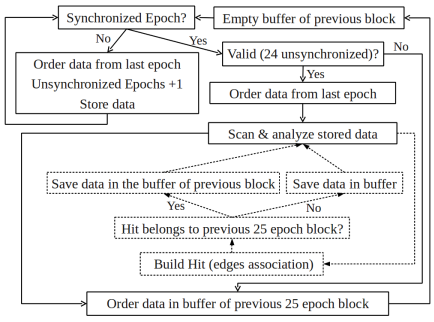

Figure 2: Cleaning and hit building procedure

The analysis procedure on data produced by this setup is organized in three steps: hit building, event building and calibration. The first step is realized inside a GO4 unpacker and consists itself of three operations described in Fig. 2: data are cleaned, reordered and used to build hits. Cleaning the data is required because the ROC transfers all data to the DABC DAQ system. This means that unsynchronized data are still present, which are useless in a multi-chip environment. Those data messages are also not time ordered because there is a token ring readout system in the digitizer chip. Finally the rising and falling edges provided by the TDC have to be matched to produce full hits with time and Time over Threshold (ToT) information.

The cleaning is done by rejecting chip by chip invalid epochs blocks, i.e. groups of 26.2144 μs periods called epochs. An epoch block is invalid when the TDC loses its synchronization with the common clock system, which can be checked every 25 epochs. The data messages must be time ordered inside each valid 25 epochs block for each chip, before being able to associate rising and falling edges in hits. As those hits are saved when the falling edge is found but must be ordered by their rising edges for event building, a buffer of two blocks and a second time ordering are necessary. The data are finally saved in a ROOT tree used by the next steps.

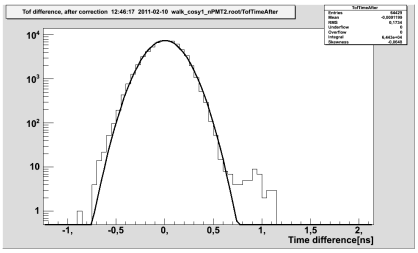

Figure 3: Time difference between reference system and one RPC strip, after partial calibration, with a Gaussian fit

The second step is done in a ROOT macro. Two options are available to build events. (i) A narrow time window is searched for the occurrence of signal coincidences. When one is found, all signals in a wider time window are associated. (ii) The ExtSync is used as reference. The data in a time window around it are put together as event. This speeds up the data analysis. The same macro can be used for both as ExtSync is saved in data as an additional "fake" channel.

The third step is also done by a ROOT macro. The calibration consist of the walk correction on the 4 main PMTs and the 2 RPC channels corresponding to one strip. Figure 3 shows an example obtained with beam test data.

References

[1] I. Deppner *et al.*, *Performance of a differential CBM-TOF demonstrator*, this report

[2] J. Frühauf *et al.*, *Status of the CBM-TOF readout chain*, this report